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AN EVALUATION OF MERCURY CONTAMINATION IN THE TOMBIGBEE RIVER
NEAR AN INDUSTRY WITH A HISTORY OF MERCURY DISCHARGES

Prepared by; Fish and Wildlife Enhancement Office
U.S. Fish and Wildlife Service
Daphne, Alabama

BACKGROUND

In 1952 Olin Corporation began operation on the Tombigbee River at McIntosh, Washington County, Alabama, with the manufacturer of chlorine and caustic soda using the mercury cell process.

A principal disadvantage to the mercury cell process is the discharge of mercury with the brine water as a waste product. Prior to 1981 brine sludge containing mercury was discharged to containment ponds where the solids were allowed to settle out. Analyses of these sludge samples were found to contain mercury at levels ranging from 111-498 ppm. As a result of leachate from these ponds, mercury as well as a number of other materials entered and contaminated the area groundwater. It is also probable that mercury was a component of the company's wastewater discharge and contaminated area surface waters.

Groundwater in this area generally flows southward from the north property boundary. It then splits into two components, eastward and westward. The eastward component discharges to the Tombigbee River, which is approximately 1 mile east of the plant. The westward component discharges into the Bilbo Creek drainage approximately 3 miles southwest of the Olin facility.

Until the mid 1970's Olin discharged their effluent directly into a 100 acre lake, known as the Olin Basin, located between the plant and the river. It was later redirected into a canal that connects the basin with the river. During low river stages this canal is the only link with the river. However, during high water the river and the basin interact at a number of points.

The Tombigbee River receives area groundwater as well as effluent, via the Olin Basin, from the Olin facility. Since these waters are known to be contaminated with mercury, concern has risen as to the status of the river. In order to address these concerns the U.S. Fish and Wildlife Service's Daphne Field Office surveyed the lower Tombigbee River during the summer of 1989 to determine mercury uptake levels in sediments and fish.

STUDY OBJECTIVES.

The study was designed to determine if mercury contaminated ground and surface waters associated with past activities at the Olin facility have impacted the Tombigbee River. Sediment samples were collected from the river above and below the plants discharge to determine areas of impact and the extent of downstream contamination. It was anticipated that sediments would provide a good historical record of mercury discharges into the river. Two species of fish, largemouth bass and channel catfish, were collected to determine if mercury found in the river sediments was bioavailable to endemic river biota and which of these species has the greatest affinity to concentrate mercury.

STUDY DESIGN

Six stations were established in the Tombigbee River above and below the Olin outfall, Fig.1. The first station was located 5 miles upstream of the Olin discharge point as a baseline station to establish area background levels. Station locations proceeded downstream at an approximate 5 river mile separation with the last station 1.0 miles upstream from the mouth of the Alabama River.

Composite sediment samples were taken from the right and left banks at each station with the exception of stations two and three where only right bank samples were collected. Particular emphasis was placed on collecting only sediments with high organic content. Sand or gravel bottom material was avoided to the point that if that was the only substrate available the sample was not taken.

A five fish composite of largemouth bass and channel catfish was to be collected at each station. Priority was given to the more mature adult individuals with a longer resident time in the river. Analyses were run on whole fish samples to provide a better assessment of uptake and availability through the foodchain.

RESULTS

Mercury results from fish and sediment samples were reported as ug/g dry weight. In order to compare these values with the historical data base, the results have been converted to wet weight values. Therefore, all mercury levels in fish discussed in this report are wet weight values. Because of the low concentrations of mercury found in the sediment samples, usually near detection limits, the values were not converted and remain as ug/g dry weight.

A electrofishing unit was used to collect the fish samples which is quite effective in the upper water column but less so on the bottom in deeper waters. As a result, the largemouth bass samples were easily collected at all stations whereas channel catfish were more difficult.

The highest mercury residue levels reported, 0.95 ug/g, were found in largemouth bass at station #2 located immediately upstream of the Olin discharge. Channel catfish collected from this same site had much lower levels, 0.15 ug/g, than the bass but were highest reported for catfish during the study. This correlation in relative concentrations remained throughout the study with largemouth bass exhibiting considerably higher mercury levels than channel catfish.

Mercury levels in bass collected at the remaining stations were relatively consistent ranging from 0.20 ug/g at station #4 to 0.26 ug/g at station #5. The site upstream of the Olin discharge, station #1, reported a value in bass samples of 0.21 ug/g, near the low end of the range. Although catfish were found with lower values they did occur throughout a somewhat wider range, from 0.04 ug/g at station #1 to 0.15 ug/g at station #2.

The U.S. Fish and Wildlife Service operates the National Contaminant Biomonitoring Program (NCBP) with over 120 stations nationwide. For the most recent year of compiled data, 1984, 29 stations collected largemouth bass for mercury analyses. The values ranged from 0.02 to 0.37 ug/g with a mean of 0.14 ug/g. All of the lower Tombigbee River bass samples exceeded the national network mean with values occurring in the upper half of the range. The concentration found at station #2 greatly surpassed any value for all species analyzed from the network during 1984.

Channel catfish collected for the NCBP during 1984 ranged in mercury levels from 0.02 to 0.21 ug/g with a mean of 0.07 ug/g. Three of the lower Tombigbee River stations were found with mercury levels in catfish equal to or greater than the national network mean. The highest value, 0.15 ug/g, at station #2 falls near the mid point of the range.

Mercury loading in the river sediments was found to be surprising low relative to the elevated levels found in fish. Values ranged from below the detection limit (0.02 ug/g) at the upstream stations #1 and #2 to 0.07 ug/g at the downstream stations #5 and #6. The variation between the right and left bank at station #6, 0.02 ug/g - 0.07 ug/g, was equal to that found between all the stations in the study area. There appeared to be no significant difference between sediment mercury levels at any of the sampled stations. Although an attempt was made to collect sediments of similar composition, the variation in mercury levels noted between collection sites could well have been due to differences in organic content and the resultant ability to attract contaminants rather than effects from mercury loading.

CONCLUSIONS

1. There was a considerable difference in the ability of largemouth bass and channel catfish to concentrate mercury, with largemouth bass being by far the more efficient. Based on the excellent ability of mercury to biomagnify through the foodchain these higher levels in bass could be the result of their being a top predator and feeding on a higher trophic level food source.
2. Mercury concentrations in largemouth bass were found to be consistently above the mean reported in the 1984 NCBP survey. The level in bass at the Olin/Ciba Geigy outfalls

was almost threefold greater than the overall highest value found during the survey.

3. Mercury levels in channel catfish were near the mean values reported from the 1984 NCBP. Only the station near the Olin/Ciba-Geigy outfall was somewhat higher than the mean. There were no stations with mercury levels in catfish that exceeded the range of values for that species collected during the 1984 NCBP.
4. There is no indication that lower Tombigbee River sediments collected within this study area function as a significant sink for mercury. Concentrations were seldom much above analytical detection limits.

RECOMMENDATIONS

The data collected during this study indicate that top predator species, i.e., largemouth bass, are effectively concentrating mercury in the lower Tombigbee River from a yet to be determined source. A site of concern appears to be in the area of the Olin/Ciba-Geigy outfalls. As a minimum, additional bass samples should be collected near these outfalls and analyzed separately for mercury. If this high value can be duplicated a comprehensive investigation should be carried out to determine the source, quantitate the amount, and, if possible, control the access of mercury to the river.

TABLE 1.
MERCURY LEVELS IN COMPOSITE FISH AND SEDIMENT SAMPLES COLLECTED
FROM THE LOWER TOBIGBEE RIVER DURING AUGUST AND SEPTEMBER, 1989

SAMPLE NO.	MEDIUM	MERCURY (ug/g)	
		DRY WT	WET WT
STATION NO 1 - RIVER MILE 66			
DA89-5-1	Largemouth bass, composite (5)	.864	.21
DA89-5-2	Channel catfish, composite (2)	.14	.04
DA89-5-3	Sediment, composite - Rt bank	.03	
DA89-5-4	Sediment, composite - Lt bank	.02	
STATION NO 2 - RIVER MILE 60.8			
DA89-5-5	Largemouth bass, composite (5)	3.8	.95
DA89-5-6	Channel catfish, composite (2)	.737	.15
DA89-5-7	Sediment, composite - Rt bank	.01	
STATION NO 3 - RIVER MILE 60.5			
DA89-5-9	Sediment, composite - RT bank	.03	
STATION NO 4 - RIVER MILE 55.7			
DA89-5-11	Largemouth bass, composite (5)	.744	.20
DA89-5-12	Channel catfish, composite (5)	.38	.10
DA89-5-13	Sediment, composite - Lt bank	.051	
DA89-5-14	Sediment, composite - Rt bank	.050	
STATION NO 5 - RIVER MILE 51			
DA89-5-15	Largemouth bass, composite (5)	.961	.26
DA89-5-16	Channel catfish, (1)	.28	.07
DA89-5-17	Sediment, composite - Rt bank	.04	
DA89-5-18	Sediment, composite - Lt bank	.078	
STATION NO 6 - RIVER MILE 46			
DA89-5-19	Largemouth bass, composite (5)	.985	.25
DA89-5-20	Channel catfish, composite (2)	.23	.06
DA89-5-21	Sediment, composite - Rt bank	.02	
DA89-5-22	Sediment, composite - Lt bank	.071	

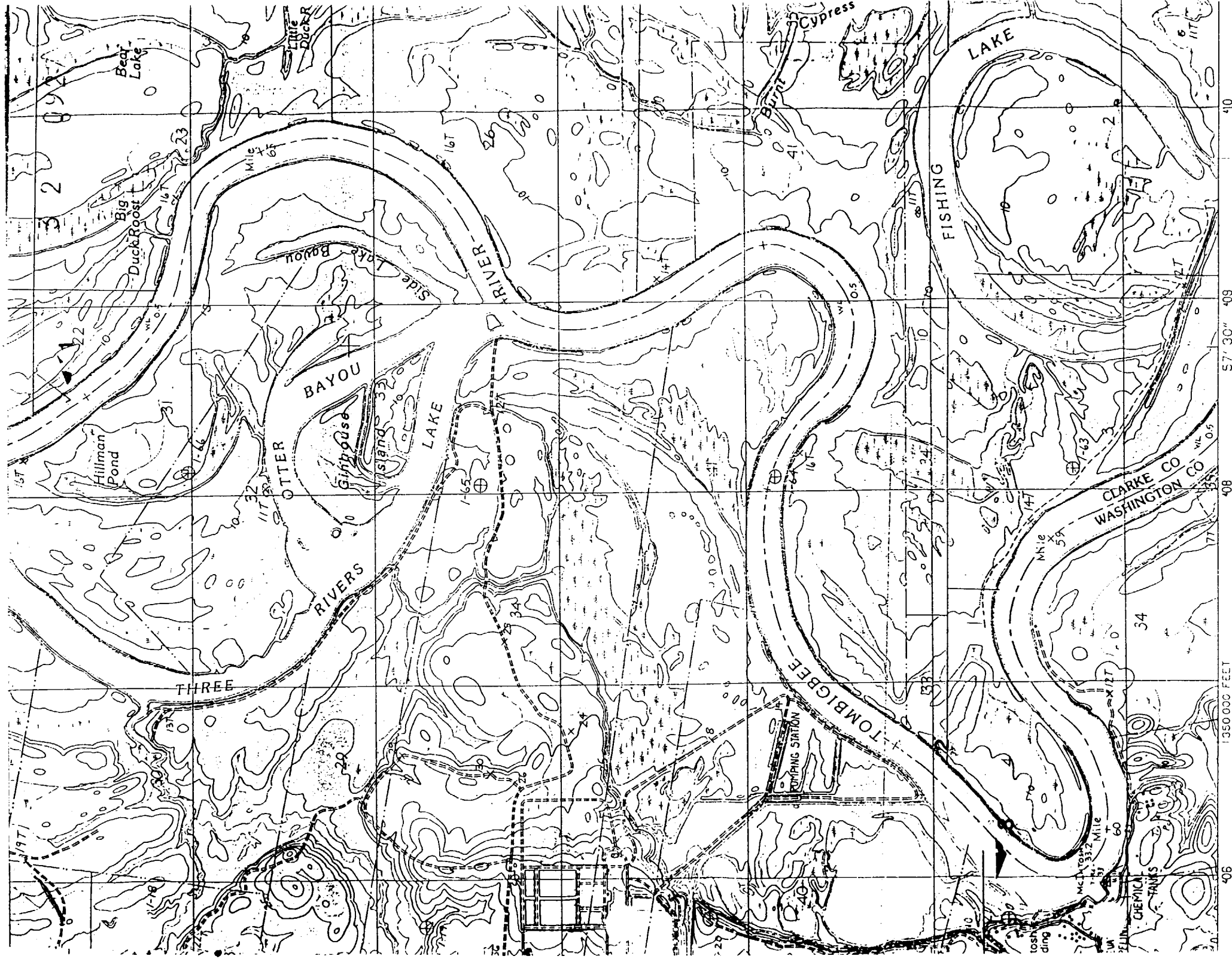


Figure 1. Study Area and Station Locations

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